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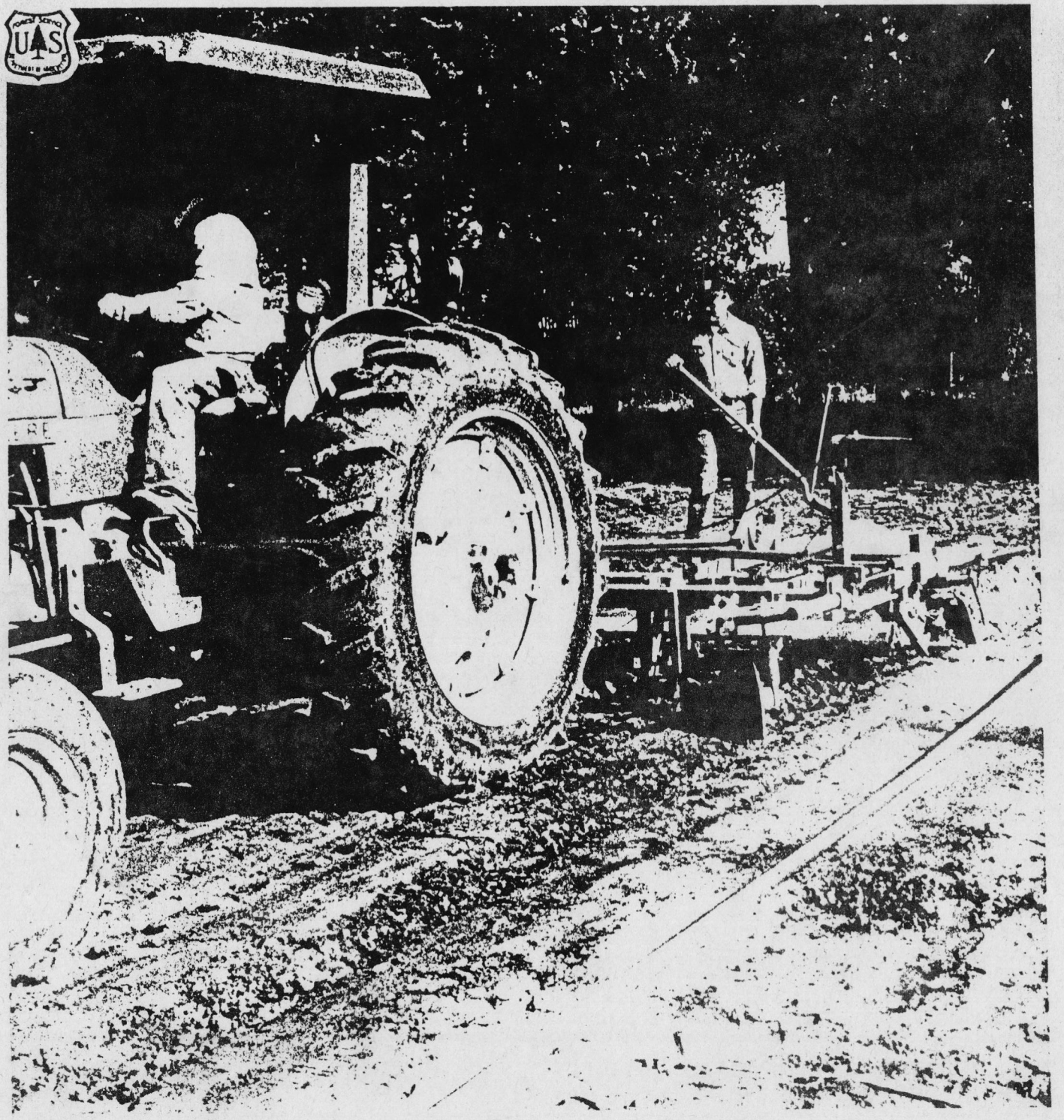
Basamid; MC-33, and Solar Heating Field Trials at Bessey Nursery



Comparisons Between Solar Heating, MC-33 Fumigation, and Basamid with Water Seal, for Fall-Sown Eastern Redcedar, Bessey Nursery, Halsey, Nebraska

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ABSTRACT

Compared to solar heating and MC-33 (67% methyl bromide and 33% chloropicrin), soil treatment with Basamid (dazomet) resulted in significantly better survival and height growth of eastern redcedar after one growing season. Weeds were best controlled by MC-33. For controlling Fusarium spp., Basamid and MC-33 were similar in effectiveness, while solar heating was not effective.

Introduction

Fumigation with methyl bromide/chloropicrin before sowing is practised on a regular basis at most federal tree nurseries (Ruehle 1986). Because of human health hazards associated with fumigation, alternative chemicals and cultural practices continue to be tested.

In a previous study at Bessey Nursery, Halsey, Nebraska, Hildebrand and Dinkel (1988) found that soil solar heating, granular Basamid (dazomet) (both water-sealed and polyethylene-sealed), and MC-33 (67% methyl bromide with 33% chloropicrin) were all effective in reducing populations of plant-parasitic nematodes. Data on the comparative effectiveness of the treatments for control of soil-borne fungi were inconclusive, and no seedling survival data were available.

Objective

The objective of this study was to gain further information on the comparative effects of the same treatments (excluding Basamid sealed with polyethylene because of prohibitive cost) on populations of Fusarium spp., weeds, and on the survival and growth of fall-sown eastern redcedar (Juniperus virginiana).

Materials and Methods

Treatments were the same as reported in 1988 (Hildebrand and Dinkel) except none of the area treated with Basamid was sealed with polyethylene, and treated areas were larger in size. The area treated by solar heating was 3 beds wide (beds 4 ft wide) by 165 ft long. Temperature data was not taken during the 6 weeks of solar heating. The area treated with Basamid was 9 beds wide by approximately 180 ft. The area treated with MC-33 (67% methyl bromide and 33% chloropicrin) was the rest of the block, over 24 beds wide by approximately 200 ft, but only 6 nearby beds were sampled for this study.

Assay of soil samples for population levels of Fusarium was done at the Forest Pest Management (FPM) Lab in Lakewood, Colo. Soil was sampled a few days before each treatment and a few days before sowing. Ten samples from each treatment area were collected at each sampling time (before and after treatment). Each sample consisted of 5 cores from a one-inch diameter soil probe inserted to a depth of 6 inches (a central core plus four cores collected about 1 ft from the central core in each of the four cardinal directions). The 5 cores of soil were placed in a ziplock bag and labelled. Samples were kept cold enroute to the laboratory. Ten samples were collected at regular intervals over each treatment area at each sampling time. The probe was wiped with a paper towel, brushed with alcohol, and wiped dry between samples.

In September 1990, after one growing season, Nursery personnel collected approximately one pint of soil from 5 different locations within each of the treatments. PeninsuLab (Kingston, WA) assayed the soil samples for populations of plant-parasitic nematodes.

In November 1990, after seedlings were hardened off for the winter, growth effects were measured on 50 seedlings for each treatment. A counting frame (one ft wide) was placed at regular intervals 5 times per treatment, and the first 10 seedlings encountered in the center of the frame were measured for height and caliper.

Calendar

1989

June 26--Plow under grass cover crop in solar heating treatment area.

July 3--Plow under grass cover crop for MC-33 and Basamid treatment areas.

July 7--Collect pre-treatment samples from Solar heating and Control areas.

July 10--Solar heating treatment: water to field capacity and seal with polyethylene.

July 24--Pre-treatment samples for MC-33, Basamid, and Control areas.

July 25--Basamid treatment: Apply granular material, till, pack, water lightly to seal surface.

Lightly water Basamid area to keep soil surface from cracking--as needed.

August 3--Till Basamid area to release vapors.

August 7--Fumigate with MC-33.

August 14--Remove polyethylene from MC-33 area.

August 21--Sow a few oat seeds in Basamid and Control areas to check for residual toxicity.

August 24--Remove polyethylene from solar heated area and collect post-treatment soil samples from all treatments.

August 28--Sow eastern redcedar.

1990

April--Measure weed cover in 10 counting frames within each treatment area.

July--Collect data from bed inventories when done by Nursery.

September--Collect soil samples for nematode assay, 5 samples from each treatment area, ship soil to Peninsulab for nematode assay.

November--Measure caliper and shoot height for 10 seedlings centered in counting frame at 5 random locations in each treatment area (50 seedlings).

RESULTS

Fusarium, Summer 1989

Before treatment, population levels of Fusarium spp. were moderate in Check and MC-33 areas, and low in Solar and Basamid areas. After treatment, levels were low in MC-33 and Basamid areas, low to moderate in the Solar area, and moderate in the Check area (Table 1). At moderate levels, one can expect pockets of damping-off and later Fusarium root rot for most conifer seedlings, but eastern redcedar is highly resistant to this pathogen. At Bessey Nursery, fumigation is used mainly for control of weeds and nematodes for Eastern redcedar.

Table 1. Population levels in PPG (propagules per gram of oven-dried soil) of Fusarium spp. in soil samples taken before and after treatments, Bessey Nursery, summer 1989.

Treatment	PPG of Fusarium Before			PPG of Fusarium After		
	Range	Average	Level	Range	Average	Level
Check (No treatment)	612-16,782	2765	Moderate	1037-4928	2210	Moderate
Solar	74- 2370	526	Low	0-3556	1090	Low to Mod
Basamid	271- 1367	753	Low	0- 74	7	Low
MC-33	600- 4477	2635	Moderate	0-2481	330	Low

Weeds, Spring 1990

The check area was sown to grass cover crop, and further data were not collected. By May 1990, two of the solar heated beds were plowed under due to excessive weed growth. Weed cover was estimated in April 1990 in at least 11 sample plots per treatment. The average weed cover in the solar-heated area was 22.2 percent, ranging from 10 to 36 percent. In the Basamid area, average weed cover was 8.3 percent, ranging from 1 to 15 percent. In the MC-33 area, average weed cover was 0.4 percent, ranging from 0 to 4 percent.

Seedling Survival, Summer 1990

Bed inventory was conducted by the Nursery on July 30, 1990. The remaining solar heated bed averaged 22 seedlings per bed-ft or 6 seedlings per square ft. The inventory plot with the least survival had 10 and the most 40 seedlings per bed-ft.

For the 9 beds treated with Basamid, average survival per bed ranged from 40 to 103 seedlings per bed-ft, with an average of 79 seedlings per bed-ft or 20 seedlings per square ft. The inventory plot with the least survival had 24 and the most 108 seedlings per bed-ft. The worst beds were adjacent to the solar heated area.

For the 6 beds sampled in the MC-33 area, average survival per bed ranged from 38 to 64 seedlings per bed-ft, with an average of 52 seedlings per bed-ft or 13 seedlings per square ft. The inventory plot with the least survival had 8 and the most 107 seedlings per bed-ft. The worst plots were scattered.

Nematodes, Fall 1990

No nematodes parasitic on conifers were found in any of the five samples per treatment. Two of the MC-33 and one of the Basamid samples had, respectively, 50, 25, and 75 Trichodorus worms per pint of soil. This nematode is apparently a parasite on the grassy cover crops, but not on conifers, and is commonly found at Bessey.

Seedling Growth, Fall 1990

Seedling caliper averaged 2 mm, with no difference between treatments. Height of seedlings (with standard deviation in parentheses) averaged 9.8 (2.5) in the MC-33 area; 10.3 (2.5) in the solar heated area; and 11.9 (2.4) in the Basamid area. At least some of the good growth in the solar heated area is attributed to lack of competition. Single classification analysis of variance showed that seedling height growth differed significantly ($P < .001$) between treatments (Table 2).

Table 2. Analysis of variance of seedling height growth between treatments (MC-33, Basamid, and Solar) with 50 seedlings sampled per treatment.

Source of Variation	Degrees of Freedom	Mean Square Term	F
Among Treatments	2	60.50	9.88***
Within Group Error	147	6.122	

*** Significant at $P < 0.001$.

DISCUSSION

The results of this field trial indicate that for survival of eastern redcedar, Basamid with a water seal is as good and perhaps better than fumigation with MC-33. The poor survival in spots with the MC-33 treatment probably resulted from clogged injectors. Survival in the Basamid area was consistently good, except for the edge that bordered the solar treatment.

Seedling height growth was significantly better in the Basamid treated area. Poor survival and the resultant lack of competition are assumed to have contributed to the good height growth of seedlings in the solar heated area. Seedling height growth was the least in the MC-33 treated area.

Weeds were best controlled by MC-33, while Fusarium spp. were controlled approximately equally well by both Basamid and MC-33. Solar heating was not as effective as the chemical treatments in control of Fusarium spp. or weeds.

Cost of application of Basamid is approximately equal to that of MC-33, and there is no contaminated polyethylene requiring disposal. Like methyl bromide fumigation, Basamid produces highly toxic gases and great care is still required, but the granular application is safer. Use of Basamid requires several more days for the gases to dissipate from the soil before sowing.

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